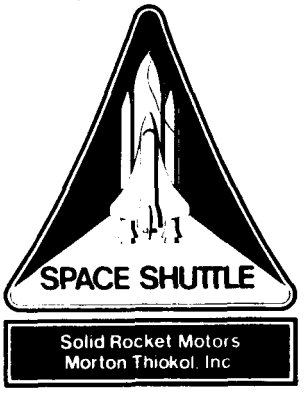
Ray Mitchell SA40



TWR-18964

EVALUATION OF EXTENDED TIME LAPSES BETWEEN COATS OF CHEMLOK 205 AND/OR 233

FINAL REPORT

11 MAY 1989

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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CONTENTS

Reference: TWR-18546 "Effects Of Chemlok 233 Sags, Runs, and Overspray on Bond Strength"

1.0 INTRODUCTION

At times, thin spots of Chemlok 233 have been observed on RSRM case segments. This study examined the effects of spraying a second coat of Chemlok 205 and/or 233 after the case has set for an extended period of time. The effects of heavy runs in the Chemlok 205 and phenomenon of the runs being a degradation in the NBR insulation to the RSRM case bond were also evaluated.

Results show that the time delays, runs, and sags do not degrade the NBR-to-case bond. However, extreme thicknesses of more than five mils does allow Chemlok to fail cohesively. Extreme thicknesses of Chemlok could be a contributing factor to edge unbonds if the anomaly is within one inch of the edge of the insulation.

2.0 TEST OBJECTIVES

1. To determine if applying a second coat of Chemlok 205 and/or 233, after the first coat has set up for a long period of time (five days), degrades the bond.

2. Monitor process parameters to ensure that thickness specifications are met.

3. To test bond integrity when Chemlok 205 runs and sags.

3.0 CONCLUSIONS

1. Delays between multiple coats of Chemlok 205 and multiple coats of Chemlok 233 have no adverse affect on bond strength.

2. Major and minor runs of Chemlok 205 did not degrade the bond strength of NBR-to-steel bond. However, extreme thicknesses of more than five mils does allow Chemlok 205 to fail cohesively as seen on Panel C in Peel Specimen Nos. 3 and 4. This type of failure was propagated from a scribe mark. Extreme thicknesses of Chemlok 205 could be a contributing factor to edge unbonds if the anomaly is within one inch of the edge of the insulation.

3. Overspray of Chemlok 205 does not degrade the bond strength.

4. There is no variation from the control bond strength values that can be attributed to a surface roughness of 32 R_a.

5. If the recommended Chemlok application process parameters are followed, full coverage will be realized.

4.0 RECOMMENDATION

It is recommended that:

1. No sags or runs of Chemlok 205 be allowed within one inch of the NBR insulation-to-case bond surface edge.

2. A second coat of Chemlok 205 or 233 should be applied if the first coat is deemed too thin.

5.0 DISCUSSION

Testing in accordance with ETP-0437 has been completed. Results indicate that time delays between multiple coats of Chemlok 205 or Chemlok 233 do not affect the strengths of the NBR-to-case bond. Extreme thicknesses (above 5.0 mils) of Chemlok 205 can lead to a loss in structural integrity.

Peel and tensile tests were performed on 8-in. x 10-in. panels that were coated with Chemlok 205 and Chemlok 233. Process anomalies were duplicated. Extreme examples of drips and sags of Chemlok 203 and Chemlok 205 were made, Chemlok 205 overspray was produced, and time lapses of five days were allowed between second coats of Chemlok 205 and/or Chemlok 233.

Thicknesses were measured on ASTM test panels, and it was noted that it was difficult to obtain thicknesses above five mils. After the anomalies had been produced, five peel and eight tensile specimens were layed up on each panel and cured. All samples had similar values to the control and failed cohesively in the rubber. On Panel C (Figure 1) cohesive failure was observed in the Chemlok 205. This suggests that if extreme thicknesses of Chemlok 205 are present, a crack (in this case, the score mark) can propagate in the thick Chemlok and cause bond failure. Failure of this type would tend to occur at the edge of the NBR-to-case bond. Therefore, it is important that caution is used when applying Chemlok in the edge bond region.

Multiple coats of Chemlok 205 or Chemlok 233 can be applied if the first coat of each does not reach full coverage. The peel and tensile specimens had similar bond strengths as the control.

A forward casting segment was monitored during Chemlok application. Process parameters were met, and were as follows:

Nozzle size	163 - 512
Spray pressure	2,100 psi
Gun distance	18 inch
Basket speed	18 ipm
Rotational speed	4.5 rpm

Full coverage was realized for both Chemlok 205 and Chemlok 233 at the measured thickness of 0.7 mils per coat.

6.0 INSTRUMENTATION

All instrumentation, measuring, and test equipment and/or systems control and calibration requirements will conform to Morton Thiokol, Inc. Space Operations Management Procedure 2710-33-00001 which conforms to MIL-STD-45662. Also, all calibration information will be maintained on file by Morton Thiokol, Inc.

6.1 Chemlok Thickness Measurements - The Accuderm eddy current thickness gage was used in accordance with EOP E-1420.

6.2 Chemlok Viscosity - The Zahn No. 1 viscosimeter cup was used in accordance with EOP E-1411.

6.3 Peel Testing - The following instruments were used to perform 45-degree peels:

Baldwin Universal Tester, Property No. X-M26055

Riehle Tensile Machine, Air Force Property No. 213887

6.4 Tensile Testing - The following instruments were utilized for the tensile testing:

Statec Tensile Machine, Property No. X-M22056

Baldwin Universal Tester, Property No. X-M26055

Riehle Tensile Machine, Air Force Property No. 213887

Instron Tensile Machine, Property No. X-M33547

7.0 PHOTOGRAPHY

Photographs were taken after Chemlok anomaly application and after peel testing. Photos that are not included in this report will be kept on file in Process Engineering.

8.0 TEST DATA REQUIREMENTS

1. Data are required to determine if a second coat of Chemlok 233 applied over the first coat (after it has set for five days) degrades the integrity of the NBR insulation to the RSRM case bond.

2. To determine if excess Chemlok 205, in the form of runs, causes degradation in bond strength.

9.0 TEST PROCEDURE

1. Grit blast and degrease all panels.

2. Polish panel H to a <32 R_a finish.

3. Spray Chemlok 205 adhesive primer with an airless spray gun with a 163 - 512 ozzle.

NOTE

All viscosities are to be 37 - 43 seconds using a No. 1 Zahn cup for all sprayed materials.

4. Measure thickness using the Accuderm electronic gage.

5. Spray Chemlok 205 after five days.

6. Measure thickness using the Accuderm electronic gage.

7. Use undiluted Chemlok 205 to make minor runs down the length of the bonding surface. A minor run is defined as a run less than one inch wide.

8. Measure thickness using the Accuderm electronic gage.

9. Use undiluted Chemlok 205 to make major runs down the length of the bonding surface. A major run is defined as a run greater than two inches wide.

10. Measure thickness using the Accuderm electronic gage.

11. Spray Chemlok 205 to produce dry overspray by using a 36-in. standoff. This is done because it is assumed that a dry coat of Chemlok degrades the bond.

12. Measure thickness using the Accuderm electronic gage.

13. Take photographs of plates.

14. Spray Chemlok 233 adhesive using the airless gun.

15. Measure thickness using the Accuderm electronic gage.

16. Spray Chemlok 233 after five days.

17. Measure thickness using the Accuderm electronic gage.

18. Lay up and cure NBR in the manner of normal sample process.

19. Perform peels at 45 degrees and at the crosshead speed of 2.0 ipm.

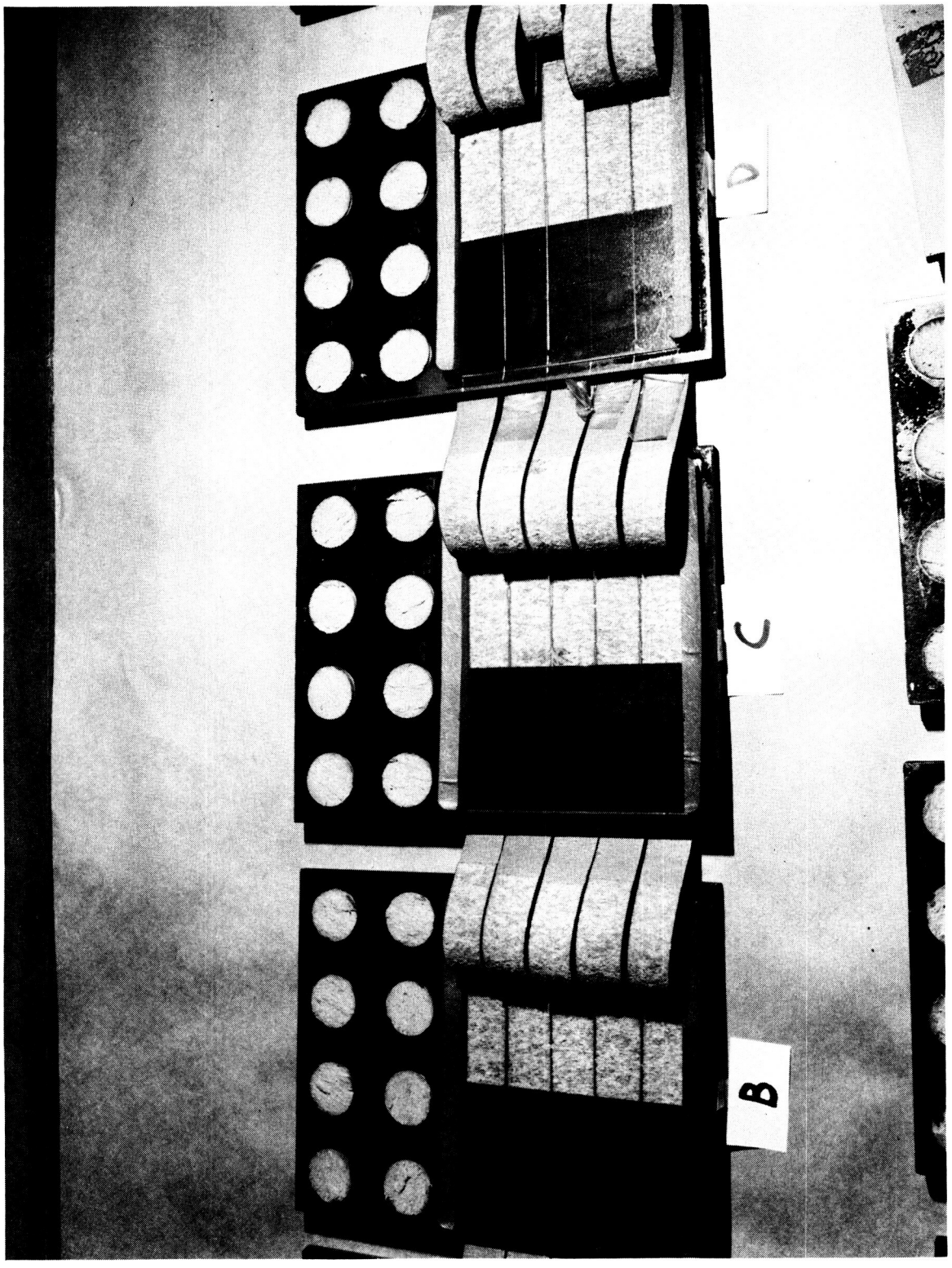
20. Perform tensile test at 0.5 ipm.

10. STATISTICAL ANALYSIS

A statistical analysis was performed on the test data. Results show that all data fall within plus or minus two standard deviations of the control. Also, a "t" test was used, which shows no significant data points. All panels are within acceptable range from the control panel bond strengths.

TABLE I. Test Matrix and Results

	PANELS							
	A	B	C	D	E	F	G	H
Grit Blase/Degrease	X	X	X	X	X	X	X	X
Polish to <32 R_a								X
Spray Chemlok 205 Primer	X	X	X	X	X	X	X	X
Second Coat Chemlok 205 (After five days)		X					X	
Chemlok 205 - Minor runs			X					
Chemlok 205 - Major runs				X				
Chemlok 205 - Overspray					X			
Spray Chemlok 233 Adhesive	X	X	X	X	X	X	X	X
Second Coat Chemlok 233 (After five days)						X	X	
Peel and Tensile Test	X	X	X	X	X	X	X	X
Avg Peel Strength (pli)	173.1	175.6	172.3	172.8	174.2	167.0	195.3	173.8
Avg Tensile Strength (psi)	765	835	823	745	793	756	696	754


B
C

DISTRIBUTION	M/S
R. B. Adams	B10
B. C. Anderson	431
L. G. Bailey	L10
F. B. Baugh	L21
S. J. Bennett	280
T. R. Braithwaite	L31
V. T. Bush	Huntsville
B. G. Butts	Longhorn
S. H. Cardall	243C
T. W. Carter	400
T. F. Christensen	203
R. L. Davis	E00
L. G. Dodd	KSC
N. F. Eddy	L21
J. W. Edwards	350
L. J. Evans	E12
E. L. Gray	L40
M. M. Hash	203
G. R. Jepson	L10
W. B. Johnson	411
R. T. Kirkham	312
S. B. Kulkarni	L00
R. C. Laramee	286
R. D. Larson	851
R. K. Lund	200
A. J. McDonald	G00A
S. Mildenhall	L40
B. D. Owen	Longhorn
P. C. Petty	L10
K. W. Phillips	Elkton
T. F. Pinkerman	MSFC
L. W. Poulter	243
D. L. Rice	203
S. A. Rolen	Louisiana
P. G. Russell	242B
C. A. Speak	E12
L. E. Seidner	203
G. Thompson	240
D. G. Turner	370
J. F. Twohy	L10
J. R. Wells	G00
C. R. Whitworth	L40
Process Engineering File	203
Technical Library	K21